

APPLES

Cultivars

The apple cultivar situation is changing rapidly across the country and within Pennsylvania. While the 2002 Pennsylvania Tree Fruit Survey indicates that Delicious and Golden Delicious are the state's two leading cultivars, several new cultivars are being widely planted.

Consider thoroughly which cultivars to plant. The first consideration is to determine how you intend to sell the fruit. Roadside markets, pick your own, and, to some extent, wholesale fresh market growers all need a continual supply of products. Therefore, it is important to choose cultivars that will accommodate an extended marketing period.

Information about various cultivars and their ripening sequences can be found in nursery catalogs. However, you should avoid being carried away by claims about a strain or cultivar—remember that nurseries are in the business of selling fruit trees. New to this edition of this guide is the addition of Table 1-6B, which lists the parentage, place of origin, and synonyms for many

of the traditional apple cultivars grown throughout the United States as well as some of the newer, experimental cultivars.

The cultivar market has recently changed with the release of cultivars that have restrictions on the sale of the trees and/or the fruit. “Club” or “controlled supply” cultivars have been established to control oversupply in the market and enhance the dollar return to the grower. These restrictions can take multiple forms. Some cultivars are restricted geographically by only allowing certain areas to grow the fruit. Some are restricted by marketing constraints where the fruit must meet a minimum quality standard to be labeled. Finally, some cultivars may be restricted by only allowing a certain number of trees to be propagated, thereby controlling the overall supply of the fruit. Pacific Rose™ and Jazz™ are two club cultivars that require the grower to pay an “entrance fee”—purchase the trees then pay a percentage of the gross returns to a marketing firm. Kiku Fuji is another club cultivar that has no entrance fee, but in order to label the fruit Kiku Fuji, they must be graded to specific standards. Common current apple cultivars grown in the United States or Canada that are managed in some form include Pink Lady™,

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Table 1-6. Apple cultivars.

Cultivar ^a	Pollen viability	Bloom	Vigor ^b	Harvest	DAFB ^c range est.	S ^e	PM	CAR	FB
Akane	Good	Early to midseason	V	Early Sept.	105-110	M ^f	H	H	M
Ambrosia*	Good	Midseason	MV	Late Sept.	140-150	H	O	M	M
Arlet*	Good	Early to midseason	MV	Mid Sept.	125-130	H	H	H	M
Braeburn*	Good	Midseason	MV	Late Oct.	160-170	H	H	H	H
Cameo* (Carousel)	Good	Midseason	VV	Mid Oct.	155-165	H	M	H	M
Cortland	Good	Midseason	V	Early to mid Oct.	125-135	H	H	H	H
Crimson Crisp ^d	Good	Midseason	V	Mid Sept.	125-135	O	M	L	M
Crispin (Mutsu)	Not good	Midseason	VV	Late Oct.	160-170	M	M	M	L
Cripps Pink (Pink Lady*)	Good	Mid to late season	VV	Mid to late Nov.	180-195	H	O	O	H
Criterion	Good	Midseason	VV	Late Oct.	—	—	—	—	—
Delicious	Good	Midseason	MV–LV	Late Sept.	135-155	L	L	L	L
Earligold*	Good	Midseason	VV	Mid Aug.	95-105	—	—	—	H
Elstar	Good	Mid- to late season	V	Early Sept.	110-125	H	H	H	—
Empire	Good	Midseason	LV	Early Oct.	125-140	H	H	L	M
Enterprise ^{da}	Good	Mid- to late season	V	Late Sept.	135-145	O	M	O	O
Freedom ^d	Good	Mid- to late season	V	Late Sept.	140-150	O	O	H	L
Fortune	Good	Mid- to late season	V	Mid Oct.	150-160	L	—	—	H
Fuji	Good	Mid- to late season	V	Late Oct to mid Nov.	170-185	H	O	H	H
Gala	Good	Midseason	MV	Late Aug.	110-120	H	M	H	H
Gala Supreme*	Good	Mid- to late season	V	Early Oct.	150-160	M	M	M	—
Ginger Gold*	Good	Midseason	V	Early Aug.	95-105	H	M	H	H
Golden Delicious	Good	Midseason	V–MV	Mid Sept. to early Oct.	135-150	L	L	L	M
Golden Supreme*	Good	Mid- to late season	MV	Early to mid Sept.	125-140	M	M	L	—
GoldRush ^d	Good	Late Season	MV	Late Oct.	165-175	O	R	H	M
Granny Smith	Good	Late season	MV	Early Nov.	165-180	H	H	H	M
Gravenstein	Not good	Early season	VV	Early Sept.	110-115	H	H	H	M
Grimes Golden	Good	Early season	MV	Mid Sept.	130-145	O	L	O	M
Honeycrisp*	Good	Early season	MV	Mid Sept.	125-140	L	M	M	M
Idared	Good	Early season	MV	Early Oct.	145-160	H	H	H	H
Jerseymac	Good	Early season	VV	Mid Aug.	90-110	H	H	L	M
Jonafree ^d	Good	Midseason	MV	Late Sept.	135-150	O	L	H	M
Jonagold	Not good	Midseason	V	Late Sept.	135-150	H	L	H	H

continued

Table 1-6. Apple cultivars (continued).

Cultivar ^a	Pollen viability	Bloom	Vigor ^b	Harvest	DAFB ^c range est.	S ^e	PM	CAR	FB
Jonamac	Good	Midseason	MV	Mid Sept.	115-130	H	H	L	M
Jonathan	Good	Midseason	LV	Mid to late Sept.	135-145	H	H	H	H
Liberty ^d	Good	Early season	V	Late Sept.	140-150	O	L	L	L
Lodi	Good	Early season	V	July	65-75	H	H	H	H
McIntosh	Good	Midseason	MV	Mid Sept.	120-135	H	H	L	M
Macoun	Good	Midseason	LV	Mid Oct.	130-140	H	H	H	M
Melrose	Good	Late season	V	Late Oct.	140-165	H	H	H	L
Mutsu (Crispin)	Not good	Midseason	VV	Late Oct.	160-170	H	H	H	M
Northern Spy	Good	Late season	VV	Mid Oct.	140-160	H	H	H	H
Northwest Greening	Good	Midseason	V	Mid Oct.	130-145	—	—	—	M
Novamac ^d	Good	Early season	MV	Mid Sept.	115-125	O	M	L	L
Nova Spy	Good	Midseason	V	Mid Oct.	—	O	L	M	L
Orin	Not good	Midseason	MV	Early Oct.	145-165	H	H	M	—
Paulared	Good	Early season	MV	Early Sept.	95-100	L	H	L	H
Piñata	Good	Midseason	M	Early Oct.	145-155	L	L	L	M
Pristine ^d	Good	Early season	V	Early Aug.	90-100	O	L	L	O
Redfree ^d	Good	Midseason	MV	Late Aug.	90-100	O	L	O	L
Rome Beauty	Good	Late season	V	Late Oct.	165-170	H	H	H	H
Sansa	Good	Midseason	LV	Late Aug.	100-115	—	—	—	—
Scarlet O'Hara ^d	Good	Midseason	M	Late-Sept.	135-145	O	L	O	H
Shizuka*	Not good	Midseason	V	Mid Sept.	130-140	—	—	—	—
Silken	Good	Early season	MV	Mid Sept.	125-135	M	L	H	—
Spartan	Good	Midseason	V	Late Sept.	120-130	H	H	H	M
Spigold	Not good		VV	Mid Oct.	140-155	H	H	H	H
Stayman	Not good	Early season	MV	Late Oct.	165-175	H	L	M	M
Summer Rambo	Not good	Early season	VV	Late Aug.	90-100	H	H	H	M
Suncrisp*	Good	Midseason	V	Late Sept.	140-160	M	M	M	H
Sundance ^d	Good	Midseason	V	Mid Oct.	140-150	O	L	O	O
Sunrise	Good	Midseason	MV	Mid Aug.	95-105	O	—	—	—
Sundowner*	Good	Mid- to late season	VV	Mid to late Nov.	195-205	—	—	—	—
Tydemans Red	Good	Early season	MV	Late Aug.	90-100	H	L	H	H
Williams Pride ^d	Good	Early season	MV	Mid Aug.	85-90	O	M	O	L
Winesap	Not good	Late season	V	Late Oct.	165-175	H	L	H	L
Winter Banana	Good	Midseason	MV-LV	Late Oct.	160-170	H	H	H	H
Yataka	Good	Midseason	V	Early Oct.	145-165				
Yellow Transparent	Good	Midseason	V	Mid Aug.	65-75	H	H	H	H
York Imperial	Good	Midseason	MV	Late Oct.	170-180	H	H	H	H
Zestar!	Good	Early season	V	Late Aug.	95-100	M	O	M	M

a. Asterisk denotes newest cultivars. Some information is estimated based on data from other areas of the country.

b. V = vigorous; MV = moderately vigorous; VV = very vigorous; LV = low vigor

c. DAFB = days after full bloom

d. Scab-resistant cultivar

e. S = scab; PM = powdery mildew; CAR = cedar apple rust; FB = fire blight; — = insufficient information

f. H = high; M = moderate; L = low; O = not susceptible; — = unknown

Appreciation is expressed to Dr. Stephen Miller of the USDA Fruit Research Lab in Kerneysville, West Virginia, for additional information on disease susceptibility.

Table 1-6B. Parentage of common and new apple cultivars

Cultivar	Female Parent		Male Parent	Country/ Area of Origin	Comments/Notes	Synonyms
Akane	Jonathan	x	Worcester Permain	Aomori, Japan		Tohoku #3
Ambrosia	chance seedling			British Columbia, Canada	Possibly from Red and Golden Delicious	
Arlet	Golden Delicious	x	Idared	Wadenswil, Switzerland		Swiss Gourmet™
Autumn Gold™	chance seedling			Tieton, Washington	One parent is Golden Delicious	
Braeburn	chance seedling			Nelson, New Zealand	Possibly Lady Hamilton x ?	
Cameo™	chance seedling			Dryden, Washington		Carousel
Corail® (see Piñata)						Pinova
Cortland	Ben Davis	x	McIntosh	Geneva, New York		
Cripps Pink (Pink Lady™)	Golden Delicious	x	Lady Williams	Australia	Correctly it should be called Cripps Pink	
Delicious	chance seedling			Peru, Iowa	Possibly seedling from Yellow Bellflower	
Elstar	Golden Delicious	x	Ingrid Marie	Wageningen, Netherlands		
Empire	McIntosh	x	Delicious	Geneva, New York		
Fiesta	Cox's Orange Pippen	x	Idared	East Malling, United Kingdom		
Fuji	Ralls Janet	x	Delicious	Aomori, Japan		
Gala	Kidd's Orange	x	Golden Delicious	Wairarapa, New Zealand		
GalaSupreme	chance seedling			Wenatchee, Washington		
Ginger Gold	chance seedling			Nelson County, Virginia	One parent may be Winesap	
Golden Delicious	chance seedling			Clay County, West Virginia	Possibly Grimes Golden x Golden Reinette	
Golden Supreme™	chance seedling			Fruitland, Idaho		
GoldRush®	Golden Delicious	x	Co-op 17	West Lafayette, Indiana		
Granny Smith	chance seedling			Sydney, Australia		
Honeycrisp™	Keepsake	x	Unknown	Excelsior, Minnesota		Honey Crunch
Idared	Jonathan	x	Wagener	Moscow, Idaho		
Jonagold	Golden Delicious	x	Jonathan	Geneva, New York		
Jonathan	chance seedling			Kingston, New York		
Lodi	Montgomery	x	Yellow Transparent	Geneva, New York		
Macoun	McIntosh	x	Jersey Black	Geneva, New York		
McIntosh	chance seedling			Ontario, Canada		
Melrose	Jonathan	x	Delicious	Wooster, Ohio		
Mutsu/Crispin	Golden Delicious	x	Indo	Aomori, Japan		
Nittany	chance seedling			Biglerville, Pennsylvania	Possibly a York Imperial x Golden Delicious	
Northern Spy	chance seedling			Ontario County, New York		
Pacific Rose™	Gala	x	Splendour	New Zealand		Sciros
Paulared	chance seedling			Sparta, Michigan		
Piñata*	(Duchess of Oldenburg Cox's)	x	Golden Delicious	Pillnitz, Germany		Corail®, Pinova. Sonata
Pink Lady™	see Cripps Pink above					
Rome Beauty	chance seedling			Proctorville, Ohio		
Sansa	Gala	x	Akane	Morioka, Japan		
Silken	Honeygold	x	8C-27-96	Summerland, British Columbia		
Southern Snap™	Gala	x	Splendour	Havelock North, New Zealand		
Spartan	McIntosh	x	Newtown Pippen	British Columbia, Canada		
Spigold	Red Spy	x	Golden Delicious	Geneva, New York		
Stayman	chance seedling			Leavenworth, Kansas	Incorrectly called Stayman Winesap	
Sundowner	Golden Delicious	x	Lady Williams	Western Australia		
Sunrise	10C-10-19	x	PCF 3-120 9	Summerland, British Columbia		
Winesap	chance seedling			New Jersey?		
York Imperial	chance seedling			York, Pennsylvania		
Zestar!	State Fair	x	MN 1691	University of Minnesota		MN #1824

Tentation™ (Delblush), Cameo™, Honeycrunch™ (Honeycrisp), Ambrosia™, Piñata™, Jazz™, Sundowner™, Aurora Golden Gala, and New York 674.

Before setting out large plantings of a new strain or cultivar, always plant a few trees on a trial basis. Also try to visit or talk to growers who may already have bearing fruit of a particular cultivar.

Many of the new cultivars are being introduced from Europe, New Zealand, and Japan. The marketplace is shifting, with more emphasis on taste and quality. Produce managers are looking for different color combinations to use in displaying apples. Following are comments from around the country on some of the newer cultivars being planted. Additional information can be found in Table 1-6, and pictures of many of the cultivars can be seen on the Web at <http://tfpg.cas.psu.edu>, under “Apple Cultivars.” The harvest dates suggested in the table should produce apples with the most flavor. These periods will probably not coincide with harvest dates that are optimal for extended storage. For more information on harvesting for storage, refer to Part VI, Harvest and Postharvest Handling. The following are brief synopses of some of the more prominent cultivars.

Akane was developed in Japan as a cross between Jonathan and Worcester Permain. The fruit is medium to small in size, round to oblate, and dark red. It matures one week ahead of Jonathan. Storage life is only about 3 weeks.

Ambrosia is a very new cultivar that was found as a chance seedling in British Columbia. Its probable parents are Golden Delicious and Starking Delicious. Fruit size is medium, with an attractive red blush and faint stripes on a cream or yellow background. Storage life is rated as very good. The fruit is sweet, low-acid, very juicy, and has a pleasant aroma. Flesh color is cream and fine grained. Trees have a spur-type vegetative growth habit. Unfortunately, this cultivar has been placed in a club status and trees are only available for sale to Canada.

Arlet, also known as Swiss Gourmet, was developed in Switzerland as a cross between Golden Delicious and Idared. Apples are medium to large, round to conical, and brightly red striped. Harvest is reportedly 10 days sooner than that of Jonathan, but there is discrepancy in the literature. Fruit appearance has been very poor in the NE-183 planting at Rock Springs. Based upon this fact, we are not recommending planting of Arlet.

Braeburn is a chance seedling from New Zealand most likely of Granny Smith parentage. Fruit is oval, small to medium, with slightly red shoulders over a green background. Braeburn has a long storage life. Red mutations are being discovered, primarily in New Zealand. Common strains along with their fruit surface coloration pattern are Kumeu Crimson (striped), Joburn (striped), Hillwell (striped), Eve (blush), Redfield (blush), and Lochbuie (blush). There is disagreement over its exact maturity date. One source places maturity around Rome Beauty season. These maturity differences may be related to nitrogen fertilization practices and strains. The cultivar is very precocious and growers should be careful not to fruit the trees too soon. Trees at Rock Springs have not been very productive and may be overly sensitive to either spring frosts or chemical thinners.

Cameo was originally introduced as Carousel and was also tested as Wenatche 66. It is a chance seedling of unknown parentage. The fruit is an attractive bright red striped over a yellow-green ground color. Fruits are round to slightly elongated and medium to large in size. The flesh is firm and creamy white. Flavor has been reported as sweet-tart and well received by consumers. Storage life is reported to be up to 1 year in CA storage. Fruit matures in mid-October, after Delicious and about the same time as Braeburn.

Carousel. See Cameo.

Chinook is a cross between Splendour and Gala developed at the Summerland Research Centre in British Columbia. In the 1999 NE-183 plantings in Pennsylvania, fruit size has been extremely small. It was released due to its long storage life, but the size will probably keep this from being a viable cultivar in the eastern United States.

Corail. see Piñata.

Cortland was developed at Cornell from a cross of Ben Davis and McIntosh made in 1898. The fruit are roundish oblate, attractively red colored, with a heavy bloom. Trees tend to be precocious and set heavy crops. Being a tip bearer, growth habit is similar to that of Rome Beauty. Standard Cortland may not color well in southern Pennsylvania. Therefore, two new strains having exceptional coloring capability, Redcort and Royal Court, are recommended for planting.

Creston was developed in British Columbia as a Golden type. Fruit is medium to large with a green color that occasionally has a red shoulder. Flesh texture is firm and fine-grained. Fruit ripens around the middle of September in central Pennsylvania.

Cripps Pink (Pink Lady®) is the correct name of the apple cultivar that is being marketed as Pink Lady®. When trees are purchased, the grower receives a royalty-free license from Pink Lady® America LLC, allowing the grower to use the Pink Lady® name. It was developed in western Australia from a cross between Golden Delicious and Lady Williams. The fruit is medium in size and oblong in shape. The fruit has a pink blush over a yellow background with cream-colored flesh. The fruit has very firm flesh and has a long storage life. Trees are vigorous and upright growing, and are susceptible to fire blight. Most locations in Pennsylvania, however, do not have a long enough growing season to adequately mature the fruit. In central Pennsylvania fruit are harvested still immature around November 5.

Criterion is a chance seedling found in a Delicious and Golden Delicious orchard in Washington. Fruit is medium to large with a shape similar to that of Delicious. It is a clear yellow with an occasional red blush. Fruit matures around Rome Beauty season. The flesh is cream colored with a mildly sweet flavor that is juicy and aromatic.

Delicious is not a new cultivar, but new strains are available. Considering current economic factors, only spur types are recommended for planting. The following new spur types are available:

Ace Spur is as a limb sport of Oregon Spur and was developed by Columbia Basin Nursery. Although a spur type, it is a very

vigorous-growing spur type. Fruit color is similar to that of Oregon Spur but is earlier coloring.

Adams Apple is a very early coloring strain that developed as a limb mutation of Oregon Spur in an orchard in Washington state. Fruit develops 100 percent red color shortly after fruit set. Growth habit is similar to that of Oregon Spur.

Early Red One, although not a spur type, is a weaker-growing nonspur. It deserves mention as one of the darkest strains evaluated. In some areas, it may color too intensely.

Midnight Spur is an early solid red coloring strain developed as a mutation of Oregon Spur.

Oregon Spur II is a higher-coloring sport of the original Oregon Spur. It also develops stripes, and vigor is similar to that of its parent. Trials in West Virginia indicate that it is a heavy bearer. It will probably replace its parent in new plantings.

Redchief (Campbell) has been one of the best early-coloring strains evaluated, but one drawback is its lack of vigor. It is very precocious and if fruited too early will runt out and not fill the allotted space. If designing plantings with this strain, either use a more vigorous rootstock than other spur types or plant trees 1 to 2 feet closer in the row. This strain is no longer patented and may be listed in some catalogs simply as Campbell Delicious.

Schlect Spur, an early coloring strain that may mature earlier as well, was found in Yakima, Washington.

Superchief is a whole tree mutation of Redchief. Like its parent tree, the fruit fills in as a stripe but earlier than Redchief. The tree has the same compact growth habit, so care must be taken not to fruit the tree too soon or it may runt out.

Older strains continue to be productive, but they take longer to develop color than the strains mentioned above. Starkrimson, Oregon Spur I, Redspur, Sturdeespur, and Wellspur have consistently rated lower in color evaluations at 145 to 150 days after bloom. Growers who desire early, high-coloring strains are advised not to depend on these.

Delblush is a cross between Golden Delicious and Blushing Golden and is known in France as Tentation. Fruit size is medium. The color is golden yellow with an orange blush over the shoulders. The fruit has a slightly sweet to sub-acid flavor as grown in Pennsylvania. Harvest in central Pennsylvania in 2002 was approximately 4 days after Golden Delicious.

Earligold is another chance seedling found in Selah, Washington. Fruit size is medium, having a clear yellow finish with little or no russetting. Fruit from plantings in central Pennsylvania mature approximately 5 days before Ginger Gold. Storage life of this fruit was shorter than that of Ginger Gold. At this point, Earligold should be considered primarily for roadside market sales.

Elstar, sometimes also referred to as Lustre Elstar, was developed in Holland as a cross between Golden Delicious and Ingrid Marie. Fruit is medium to large, round to conical, with red striping over a bright yellow background. Elstar matures in early to mid-September and has a medium storage life. In Europe it is marketed as a red blushed Golden Delicious. Fruit from plantings in central Pennsylvania appear nearly solid red. Fruit is heavily russeted across the shoulders.

Enterprise. See discussion below on scab resistant apple cultivars.

Fortune was developed by Cornell University and was tested as NY429. Fruits from plantings in central Pennsylvania are large to very large with an attractive overall red color. The flesh is creamy white, and the tree may tend toward biennial bearing. At present we do not know how it will perform in the warmer areas of the state. It is popular in New England and is recommended for trial only in areas where McIntosh is grown.

Fuji was developed in Japan as a cross between Ralls Janet and Delicious. Fruit is medium-sized, round to conical. Color has been reported to vary slightly from a solid red like that of Delicious, to light red stripes over a green background. Fuji was heavily planted in California, but poor finish and low packouts have made many growers topwork their trees over to Cripps Pink (Pink Lady) and/or Sundowner. When Fuji was originally planted in Pennsylvania, we had doubts that the growing season was long enough to mature the fruit. It now appears that in most years warmer areas can mature the fruit. However, the strong biennial bearing habit that we observed has not changed and may be related to how long autumn remains warm after harvest. In a replicated trial at Rock Springs, the Myra strain of Fuji is significantly larger than the Sun, BC#2 or Yataka strains. Although yields in 2002 were light due to late-season frost, Myra had the greatest yield of the four strains. BC#2 had the largest mean fruit weight; however, this may have been due to having the lightest crop load. Red sports are being developed and released. Following are some comments on the various available strains:

Akifu #7 is a blush selection from Japan released in 1986.

Autumn Rose is a full tree mutation of Nagafu 12 found in Oregon.

Auvil Early Fuji was discovered in Washington and ripens 6 weeks before standard Fuji. It contains apple mosaic virus and therefore should not be grafted onto G.16 rootstock.

Brak (Kiku®) is a branch mutation found in Japan by a grower from Italy. This strain, if it meets grading standards, will be sold under the brand name of Kiku® Fuji.

Lynd's Spur Fuji was found at Lynd's orchard in central Ohio, but the color pattern has not been reported.

BC#1 (Moriho-fu #1) is an irradiated selection from Japan that develops a red blush color pattern.

BC#2 (Moriho-fu #2) is another irradiated selection from Japan that develops a striped color pattern.

Daybreak Fuji (Rankin strain) was found as a limb sport of Yataka in an orchard in Adams County, Pennsylvania. It ripens about 5 days ahead of Yataka and has better color and a smoother skin.

Jubilee Fuji (formerly known as *September Wonder Fuji*) is an early maturing strain of standard Fuji. In 2002 it ripened in mid-September in Pennsylvania and had excellent fruit color. Flavor in 2002 was only moderate and would have benefited from staying on the tree longer.

Nagafu #2, *Nagafu #6*, and *Nagafu #12* were all developed at the Nagano Research Station in Japan. Nagafu #6 is a striped red, while the other two are blush colored. Of the three, Nagafu #2 is reported to develop the most color.

Sun Fuji is a sport discovered in California and is reported to have a better color than any of the other strains.

Beni Osho is reported to be a red sport of Yataka.

Myra Red Fuji (Broetje strain) is a red sport found in the Pacific Northwest.

TRECO® Red Fuji (Cooper strain) has a red striped color pattern.

Top Export Fuji (Snyder strain) is a sport of BC#2 with better color capabilities.

Yataka was selected as an early coloring and maturing selection of Fuji. The earliness of maturity was believed to be related primarily to a heavy virus content, and virus-free trees may not have the same characteristics.

Gala was developed in New Zealand as a cross between Kidd's Orange Pippin and Golden Delicious. Fruit is small to medium in size and uniformly oval to round. The original Gala is pale to golden yellow, with bright red-orange stripes. The fruit matures at the end of August in the southern portions of Pennsylvania. Storage life is rated at approximately 3 to 6 months. Gala requires multiple pickings for best quality. Available strains include Original (Kidd's D8), Autumn Gala (Harry Black), Brookfield Gala, Buckeye Gala (Peace Valley strain), Crimson Gala (Waliser), Extra Red Gala (Wyles), Galaxy Gala (Kiddle), Gale Gala (Malaga), Imperial Gala (Tenroy), Lydia's Red Gala (Hilltop), Spur Gala (Lynd), Pacific Gala (Olsen), Regal Gala (Fulford), Regal Gala (Applewaites), Royal Gala (Tenroy), Scarlet Gala (Creech), Star Gala (Weaver), TRECO Red Gala No. 42 (Cooper), Twin Bee Gala, Ultima Gala (Banning), and Ultrared Gala (Obrogala).

Gala Supreme is a chance seedling that developed from a root sucker on a seedling rootstock in Washington. It should not be confused with Gala or any Gala strain. Fruits have up to a 90 percent attractive red stripe over a yellow ground with pronounced red lenticels. Flesh is firm, crisp, and very juicy. Fruit matures around the time that Delicious does, but should only be stored for 2 to 4 months in common storage. It is not recommended for commercial trials due to its uneven fruit color and fruit finish.

Ginger Gold is a chance seedling found in a commercial orchard in Virginia. It is sold as an early maturing Golden type, harvested in early to mid-August. Fruit finish is very smooth with little russeting. Storage potential is rated as very good. Trees are very precocious. In test plantings in central Pennsylvania, second leaf trees on M.9 size rootstocks have had up to 15 fruits per tree. Trees are susceptible to powdery mildew.

Golden Supreme is a Golden Delicious-like fruit that occasionally has a pink blush. It is a chance seedling and produces fruit that is pleasantly sweet but better and tarter than Golden Delicious. It is also more vigorous than Golden Delicious. In the NE-183 plantings, it is one of the most attractive-looking apples with very little russet. A drawback is that it has not been very precocious in the planting at Rock Springs. May need multiple harvests and tends toward biennial bearing like Golden Delicious.

Hampshire is a chance seedling found in New Hampshire that is being evaluated in the 1999 NE-183 planting. Fruit is me-

dium to large and has a well-colored red surface. It has some McIntosh-looking characteristics. Flowers may have some frost tolerance since this cultivar did not seem to be excessively affected by late frosts in 2002.

Honeycrisp was developed at the University of Minnesota and tested as Minnesota #1711R. Fruits are large with a 50 to 90 percent solid to mottled scarlet red over green. Storage life in common storage has been as long as 6 to 7 months. Noted for outstanding crispness and juiciness. Leaves of Honeycrisp frequently exhibit a green mottling during the summer. At present, we do not know if the discoloration is affecting production. The tree is not very vigorous and should not be planted on M.9 or B.9 unless they are spaced close together. For further information on this and the other cultivars recently released by the University of Minnesota, go to <http://www.apples.umn.edu/nurseries/posters.html>.

Jonagold was developed in New York as a cross between Golden Delicious and Jonathan. Although introduced in 1968, Jonagold has become more popular in Europe. Because of this demand, however, it is gaining favor in the United States. Jonagold is rated as one of the best-tasting apples. Fruit is large and conical, similar to Golden Delicious. Jonagold may have only medium storage potential. It is a vigorously growing triploid and therefore cannot be used as a pollen source. It is also intersterile with Golden Delicious. As with Gala, red sports are being released and there is similar concern about marketplace acceptance of noncoloring strains. Some of the more popular strains are: Morren's Jona-go-red, DeCoster (Swillen), Jonica (Schneica), Nicobel, Rubinstar (Herr), Jored (Nicolai's King Jonagold), and Wilamuta. In addition, many strains are being developed and tested in Europe. These include Crimson, Jomured, Jonabel, Crowngold, and others.

Nittany, although not a new cultivar, has recently attracted attention from many areas outside of Pennsylvania. Discovered as an open-pollinated seedling of York Imperial (pollen source may have been Golden Delicious), it has the flesh color, texture, and firmness of York. Fruit have been described as attractive, oblong, and light cherry red, with a good sweet tart flavor. It is a vigorous tree. The major problem seems to be storage and calcium-related disorders.

Orin is a cross of Golden Delicious by Indo developed in Japan. It has the same parentage as Shizuka and Mutsu. Fruit are medium to large, oblong, and yellow-green in color. The flesh is firm, aromatic, juicy, and very sweet. Test plantings at Rock Springs, however, have shown a tendency for prominent markings of the lenticels. This cultivar will probably not be of sufficient quality to be grown in Pennsylvania.

Piñata is a selection from the apple breeding program in Pillnitz, Germany. Fruit is medium in size with a bright orangish-pink skin. The flesh is cream colored, firm, and fine grained. It is an attractive apple, but it is probably best stored for a few weeks before consumption. When it was first released, it was named Corail®; the name was later changed to Pinova, then to Sonata, and finally Piñata.

Pinova. See Piñata.

Pristine. See section on scab-resistant cultivars.

RubINETTE is a high-quality introduction from the Swiss breeding

program, a cross between Golden Delicious and Cox's Orange Pippin. The fruit is described as having a brilliant red stripe over a golden ground with a faint russet. Fruit is small and has a very sweet flavor with a slight tang and aroma. Tree growth habit is like that of Golden Delicious; moderately susceptible to powdery mildew and moderately resistant to apple scab.

Sansa is attractive, crisp, aromatic, medium-sized, and sweet-flavored. It may be stored for up to 2 months. One report says that Sansa is resistant to apple scab. The fruit matures in central Pennsylvania about 2 weeks before Gala. Good-quality fruit for its season. The trees in the NE-183 planting at Rock Springs have weak vegetative growth, and it is unknown if this is the natural condition of the cultivar.

Shizuka was developed in Japan from a cross between Golden Delicious and Indo. It has the same parentage as Orin and Mutsu. Fruit is very large with a green to yellow skin that occasionally shows a pink blush. Fruit is sweeter than Mutsu, but fruit quality is not as good. Fruit is harvested in late September. Tree growth is very spreading. Shizuka is being promoted as a replacement for Mutsu because it does not appear to be susceptible to Blister spot. It is a triploid, and therefore the pollen is not viable.

Silken is a cross between Honeygold and a numbered selection (8C-27-96) developed at the Summerland Research Centre in British Columbia. It is an early apple, ripening in August. The skin has a soft, yellow, almost translucent quality. Fruit is crisp and juicy. Trees are slow growing, but precocious. Limited commercial availability.

Snow Sweet is the latest release from the University of Minnesota. It was developed from a cross between Sharon and Connell Red. The flesh is sweet with a hint of tartness and bright white that does not oxidize very easily. Tree growth habit is more willowy. Fruit ripen approximately 2 weeks after Honeycrisp. For further information on this and the other cultivars recently released by the University of Minnesota, go to <http://www.apples.umn.edu/nurseries/posters.html>.

Suncrisp (NJ 55) is a large late-season yellow apple, striped orange cheek over a lemon-yellow ground color; conic fruit with crisp yellow flesh; unique spicy flavor; good storage potential. Harvest season is about one week after Delicious. Very precocious; in the NE-183 cultivar trials in central Pennsylvania, it was among trees with the largest yields in their third leaf. Fruit quality improves with a short storage period.

Sunrise is another release from British Columbia and ripens just before Gala. Fruit color is an attractive pinkish-red over a yellow ground color that is medium in size. Fruit flavor is mild to slightly sweet.

Zestar! is the most recent release from the Minnesota breeding program. It is an early-season apple that ripens in late August. It was developed from a cross of State Fair x MN 1691. The apples are globose with an average diameter of 3 inches and are typified by a red striping. As a young tree the growth habit is upright. It is susceptible to fire blight. Growers should only make trial plantings of this cultivar. For further information on this and the other cultivars recently released by the University of Minnesota, go to <http://www.apples.umn.edu/nurseries/posters.html>.

(Some of the information on specific cultivars was compiled from Pacific Northwest Fruit Testing Association materials as well as the NE-183 Web site, <http://www.ne183.org/>.)

Scab-resistant cultivars

Many scab-resistant cultivars have recently been released as a result of breeding programs in the United States and elsewhere. They were developed primarily for resistance to apple scab, but some are also resistant to cedar apple rust, powdery mildew, and fire blight. Disease resistance does not mean total freedom from pesticides, since none of these cultivars are immune to insect damage or summer diseases like sooty blotch or flyspeck. There are some new cultivars coming from Germany that will have multiple resistances to such diseases as powdery mildew and fire blight, among others. These are being marketed as "ReZista Series." For a listing and images of many of the scab-resistant cultivars, go to http://fpath.cas.psu.edu/FIELD_DAY/field%20day%202006/Srcs.htm.

Earlier releases such as Prima and Priscilla were not well accepted because of poor fruit quality. Since their release, newer cultivars now available may have promise for commercial orchards. Following are comments on selected apple-scab-resistant cultivars (see also Table 1-6):

Crimson Crisp was named by the Purdue Rutgers Illinois cooperative breeding program. It was tested as Co-op 39. The medium to dark red fruit have a cream-colored, mildly acidic, coarse flesh. The fruit will store about 6 months in regular storage. In addition to apple scab they are moderately resistant to rusts and powdery mildew. It is susceptible to fire blight. Fruit matures around the middle to end of September and hangs well on the tree.

Dayton was released in 1988. Its fruit ripens about 4 weeks before Delicious. Fruits are large with a glossy red color. Reports indicate that maximum storage may only be one month. The tree is vigorous, with strong, upright-growing branches. It has good resistance to mildew and cedar apple rust and moderate resistance to fire blight. No trees of this cultivar have been planted in Pennsylvania for evaluation.

Enterprise (Co-op 30) was released in 1993 by the PRI program as a later-maturing, scab-resistant apple cultivar. Flesh is yellow, with a 75 percent red skin. Fruit is of good quality. Flavor is very good although on the tart or acid side. Enterprise matures around October 15 in south-central Pennsylvania and about a week later in central Pennsylvania. The tree has a very vigorous growth habit. It is suggested for both homeowner and commercial trials. It is believed prone to corking, but this has been controlled in south-central Pennsylvania plantings with standard calcium chloride programs.

Freedom (NY58553-1) is ready for harvest around the end of September. Fruits are large and their external appearance is not very good, having a rough-looking finish. This cultivar does not store well, having ripened unevenly on the tree. Suggested for home plantings only.

Galarina is a Gala-like apple that is resistant to apple scab and can be stored for longer periods. It was developed in France from a Gala and Florina cross. The medium-size fruit matures 1 to 2 weeks after Gala. The skin color is 65 to 100 percent

orange-red over greenish yellow with flesh that is yellowish white. The flavor is aromatic and slightly tart. Trees are moderately vigorous.

GoldRush (Co-op 38) was released in 1993 by the PRI program and is resistant to apple scab. The tree is moderately vigorous with an upright growth habit. The fruit ripens very late. Its growing season may be too long to be planted from central Pennsylvania northward. Fruit quality is excellent, and fruit has an approximately 7-month storage period. Fruits are medium to large and have a spicy to slightly acid taste at harvest, becoming better after a period of 2 months in storage. For someone looking for a Golden Delicious type, GoldRush would work very well. Suggested for both homeowner and commercial trials.

Jonafree, released in 1979, ripens with Jonathan and has a 95 percent red overcolor much like Jonathan's, but it is less susceptible to fire blight and powdery mildew than Jonathan. Jonafree is a very hard apple that does not develop a good flavor until after a period of storage. This cultivar has very vigorous growth and tends to be a tip bearer as well as an alternate year bearer. May work for processing and for homeowner use.

Liberty (NY55140-19), released in 1978, is dark red and resistant to rusts, mildew, and fire blight. Its harvest date is the last week in September to the first week in October in State College, although one source indicates ripening is about 10 days after McIntosh. The fruit tends to be small and may require multiple pickings; flavor is better after storage. Japanese beetles favor this cultivar to the extent that extra sprays are needed to control the pest.

Nova Easygro was released in 1975 from Kentville, Nova Scotia. It is a large apple, red striped over green, somewhat like McIntosh but a deeper red. The calyx is partially open to closed. Flesh is cream-colored and of a medium coarse texture. Flavor is tart (like Jonathan). The tree is very vigorous and ripens somewhat unevenly. The quality of apples grown in State College has been fair to poor. Plantings in 1990 experienced a preharvest fruit drop. No longer recommended in Pennsylvania for either commercial or home use.

Novamac is a McIntosh type released from Kentville, Nova Scotia. In plantings at Rock Springs on M9 rootstocks, the trees have been very precocious and have been consistent croppers. The fruit looks and tastes like McIntosh. This cultivar holds promise for both backyard and commercial use in areas where McIntosh is grown. Severe preharvest fruit drop in 1994.

Nova Spy was developed in Nova Scotia as a scab-resistant "Spy-type" apple. It is a juicy, firm-fleshed red apple. It is moderately susceptible to rusts and only lightly susceptible to powdery mildew. It was developed in Canada from a cross between Nova Easygro and NY-44411-1. The fruit are attractive, moderate high quality, long keeping, and similar to Northern Spy. Fruit are medium in size, globose conical, and slightly ribbed. The flesh is creamy yellow, fine, very firm, crisp, and juicy. The fruit mature between Delicious and Northern Spy. It is an excellent processing cultivar. The tree is upright and moderately vigorous.

NY-75414-1 is an advanced selection from Cornell, developed

by crossing Liberty with Macspur. Fruit grown in central Pennsylvania are very dark red to almost purple and slightly resemble Macoun. It is harvested around the middle of September. In the NE-183 planting at Rock Springs, it is one of the weakest-growing trees.

Otava was developed in the Czech Republic from a cross between Sampion and Jolana. The globose and ribbed fruit matures with Golden Delicious and has yellow skin with a slight red-orange blush. The flesh is yellow to cream with fine-grained texture, juicy, and has a sweet subacid flavor. It is resistant to apple scab and tolerant to powdery mildew.

Pixie CrunchTM was released in 2004 from the Purdue, Rutgers, and Illinois cooperative breeding program. The blushed dark red to purple fruit have a yellow flesh that is extremely crisp, medium to fine grained, and juicy. Storage life is at best 2 months. The flavor is moderately to mildly acid. Fruit size tends to be small (2.5 inches diameter), which may decrease its value as a commercial cultivar. It is immune to apple scab, susceptible to powdery mildew, and moderately susceptible to fire blight.

Pristine was released from the Purdue, Rutgers, Illinois breeding program in 1995. It is also moderately resistant to fire blight, slightly resistant to cedar apple rust, and resistant to powdery mildew. Fruit matures with Lodi and should be used as a replacement for Lodi. Plantings at Rock Springs have been very productive. Fruit color is green to yellow.

Redfree, released in 1981, is a red-skinned summer apple. Harvest is around the middle of August in State College (6–7 weeks before Delicious). Storage life is only about 2 months; shows moderate tolerance to fire blight and powdery mildew. Tree wood is very brittle and weak. Redfree tends to be a tip bearer like Rome Beauty. Suggested only for homeowner use and possibly roadside markets.

Rubinola is resistant to apple scab and powdery mildew and matures 10 days before Golden Delicious. The trees are vigorous. The cultivar was the result of a cross between Prima and Rubin. The fruit are medium to large, flat, globose, and with a skin that is bright red over most of the surface, although some russetting can occur. The flesh is yellow, firm, fine textured, juicy, and has a sweet aromatic flavor.

Scarlet O'HaraTM was released in 2004 from the Purdue, Rutgers, and Illinois cooperative breeding program. It was previously tested as Co-op 25. It is a midseason red apple that ripens one week before Delicious. The fruit are round to slightly conic. The overcolor is described as 75 to 90 percent medium red to orange with a green-yellow to yellow undercolor. The flesh is yellow to cream colored, firm, and crisp. The flavor is sweet to mildly subacid. The tree and fruit are field immune to scab, moderately resistant to powdery mildew, highly resistant to cedar apple rust, and highly susceptible to fire blight.

Sundance was released in 2004 from the Purdue, Rutgers, and Illinois cooperative breeding program. It was previously tested as Co-op 29. The pale yellow fruit are large and attractive. They have moderate stem-end russet. The flesh is medium to coarse cream colored with a very firm and crisp texture. The fruit have good storage potential and mature about 2.5 weeks after Delicious. Fruit tastes best after about a month in

storage. Sundance is moderately resistant to powdery mildew and highly resistant to cedar apple rust and fire blight. Full details on the cultivar can be viewed in *HortScience* volume 39 number 2.

Topaz was developed in the Czech Republic from a cross between the Czech apple cultivars Vanda and Rubin. Topaz is a medium to medium-large apple. The skin color is yellow overlain with a red and crimson flush. The flesh is crisp and cream colored. The trees are moderately vigorous and very precocious. Trees are resistant to apple scab and moderately resistant to powdery mildew. Fruit matures about 1 week after Golden Delicious.

Williams Pride was released in 1988, one of the earliest-ripening cultivars released. Matures approximately 1 week after Lodi; in our plantings has matured around the middle of August. The dark red fruits are large with a semitart flavor that is very good. May have uneven ripening requiring multiple pickings. Growth observations indicate that the tree is very willowy. Suggested for homeowner use and roadside markets. Shows a strong tendency toward bitter pit.

The Future of Scab-Resistant Cultivars

Many more cultivars are being developed and tested in Europe. The Czech Republic, Italy, France, and Latvia all have active breeding and testing programs. The limitations to obtaining these cultivars is the inability to import new plant materials without going through a lengthy screening process. The other limitation to the wide adoption of scab-resistant cultivars is that most of the cultivars only carry the Vf gene for resistance. Establishing solid plantings of Vf-resistant cultivars may cause a breakdown in resistance of scab protection. In Switzerland where they have been growing scab-resistant cultivars, it is recommended that even if the cultivar is scab resistant a minimum number of sulfur sprays be applied each year to prevent the buildup of apple scab populations that can overcome the Vf resistance.

The Basics of Pruning

Fruit growers are constantly manipulating tree canopies to maximize fruit production. This is done in two ways: by pruning to remove limbs or shoots or by bending limbs or shoots in specific orientations. Pruning and training are therefore horticultural manipulations done to modify naturally occurring growth patterns within plants. The primary processes being modified are apical dominance (see below) and the natural flowering and/or fruiting characteristics of the trees.

The first point to remember is that pruning is a dwarfing process. A pruned tree will always be smaller than a same-aged tree that was not pruned. For pruning to be effective, however, it must be practiced with an understanding of how trees respond to branch or shoot removal and of how those removals affect future tree growth.

The second point to remember is that training affects primarily tree form, while pruning affects mainly function. Training determines the general character and even the details of the plant's outline and its branching and framework. Pruning is meant to determine how and when the tree will fruit. Therefore, training and pruning are two different aspects of modifying naturally occurring growth patterns. Training involves tree development and form, whereas pruning involves tree function and size.

Training takes place in the first 4-5 years of the tree's life. Pruning is conducted for the entire life of the tree. In a tree's early productive years, the goal of pruning is to contain excessive vigor. During declining years, pruning's emphasis shifts to promoting vigor and allowing maximum sunlight to penetrate the tree canopy.

Types of pruning cuts

Regardless of the kind of fruit tree (or, for that matter, kind of plant), only two types of pruning cuts are made: heading back cuts and thinning out cuts. Every other cut you may hear discussed is a variation of these two. A heading back cut is the partial removal of a shoot, limb, or branch. In orchards this may range from the tipping of leaders or branches to the use of mechanical hedging machines. A thinning out cut is the removal of an entire shoot, limb, or branch at its point of origin. In orchards this can include the removal of a primary or secondary scaffold limb, removal of a spur system, or desuckering interior water sprouts arising from horizontal limbs.

Impact of flower position

The difference in how a tree or plant responds to these two cuts is the basis for the different training systems. Concurrent with knowing how a tree responds to these two cuts is knowing where the particular species produces flowers and fruits. Every bud on a tree is regarded as a potential flower bud; therefore, flowers can occur in many areas. In general, however, they occur (a) terminally on long or short growths, (b) laterally in the axils of the current or past season's leaves, and (c) adventitiously from any point on the exposed bark of limbs, trunks, or roots (rarely).

As a rule, the position of the flower or inflorescence on the shoot relative to the current season's growth is characteristic of the species or cultivar and does not change much. In apples fruit buds are borne terminally, unfolding to produce leafy shoots that terminate in flower clusters. Most of these terminal flowers are on short shoots called spurs. However, they can occur at the ends of long shoots, especially in the "terminal bearers" such as Rome Beauty. Flowers are infrequently also found as laterals arising on last year's wood. In most instances, in Pennsylvania and the Mid-Atlantic areas, these flowers do not set fruit. When the lateral flowers do set fruit, the resulting apples are usually small and of poor quality. The proportion of spur growth and flowering sites to terminal long shoot flowers is characteristic of a given cultivar and must be assessed when pruning in the field.

Apical dominance

Regardless of basic growth habit, all trees respond similarly to a given type of pruning cut. Heading cuts remove the growing point and developing leaves if applied during the summer and the terminal bud if applied during the winter. This operation severely changes the shoot's hormonal balance and forces the plant to react accordingly. The tendency for suppression of the lateral bud break is referred to as the apical dominance of the terminal bud.

This young growing point or terminal bud is the site of manufacture of the class of plant hormones known as auxins. Removing either the shoot tip or the young growing leaves stimulates the growth of lateral buds into side shoots because of the removal of that site of auxin manufacture. The lateral buds are inhibited